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# French Gulch
# Wellington-Oro Mine Site
## Sampling Activities Report
## Breckenridge, Colorado

**2017 Sampling Events**
**Final**

**Prepared for:**

**United States Environmental Protection Agency, Region 8**
**Ecosystem Protection and Remediation – Program Support**
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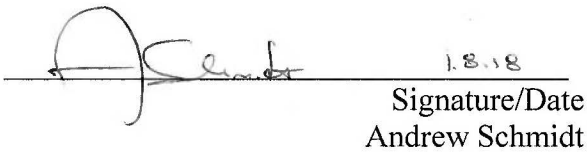

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## Distribution List
## 2017 Sampling Activities Report – French Gulch – Summit County, Colorado

The following is a distribution list of individuals that will receive a copy of the Sampling Activities Report (SAR) for the sampling events during 2017 at the French Gulch Wellington-Oro Mine Site (W-O Mine). Federal agency (United States Environmental Protection Agency [EPA]), state agency (Colorado Department of Public Health and Environment [CDPHE]) and contractor (Environmental Services Assistance Team [ESAT]) affiliations are listed for each individual.

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## Abbreviations and Acronym List

| | |
|---|---|
| CDPHE | Colorado Department of Public Health and Environment |
| COC | Chain of Custody |
| DO | Dissolved Oxygen |
| EDCD | Electronic Data Collection Device |
| EPA | United States Environmental Protection Agency |
| ESAT | Environmental Services Assistance Team |
| GPS | Global Positioning System |
| HDPE | High-Density Polyethylene |
| mL | milliliter |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RPD | Relative Percent Difference |
| SAP | Sampling and Analysis Plan |
| SAR | Sampling Activities Report |
| SOP | Standard Operating Procedure |
| W-O | Wellington Oro Mining and Milling Complex |

# 1.0 INTRODUCTION

This SAR summarizes the 2017 field activities at the French Gulch Wellington-Oro Mining and Milling Complex, located in Summit County, Colorado. Sampling efforts were conducted on May 23rd, June 13th and 14th, and September 20th and 21st of 2017 to investigate the impact of the W-O Mine on current surface water and groundwater conditions. Field activities included the collection of surface water, groundwater, field water quality measurements, and stream discharge measurements. Surface water and groundwater samples were analyzed for total recoverable metals and dissolved metals.

This report includes all data collected by the ESAT sampling team and analytical data from the EPA sampling team. However, other data such as flow measurements and water quality measurements collected from the Blue River as specified in the *Final Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) for the French Gulch W-O Mining site* (ESAT, 2017) by the EPA sampling team were not relinquished to ESAT for this document. On each event, ESAT collected samples from the French Gulch locations while EPA collected samples from the Blue River locations. This SAR includes the following sections: Sampling Activities and Procedures (Section 2.0), Sample Quality Control (QC) (Section 3.0), Field Changes and Corrective Actions (Section 4.0), and References (Section 5.0). All of the data obtained from field activities and sample analyses are provided in supporting tables and appendices.

## 1.1 Site Background and Description

The French Gulch Site includes the W-O Mine complex which was a lode mine and mill operation producing zinc, lead, gold, and silver. The Wellington Mine began operation in 1887 and was connected underground to the Oro Mine in 1903. It was the largest producing mine in the Breckenridge area reaping over $33 million and employing as many as 150 people before permanently closing in 1972. The mine extends 400 feet above the top floor of the mill and 800 feet below. There are over 12 miles of underground workings. Placer mining techniques, especially floating placer dredges in the streambeds, were also used in French Gulch and the Blue River from the mid-1800s until the 1940s. Placer mining activities removed alluvial valley materials, leaving behind piles of boulders, cobbles, and gravel, principally along stream channels.

French Gulch and the Blue River historically received trace metals loading from both groundwater and surface waters (mainly streams) impacted by mill tailings, buried roaster fines, and mine waste rock near the W-O Mine Site (Morrissey, 1995). The aquatic habitat of lower French Gulch was entirely eliminated and flows were rerouted by historic dredge mining operations. Trout populations were eliminated and aquatic benthic communities have been reduced in French Gulch downstream of the W-O Mine Site due to habitat loss and high concentrations of trace metals (primarily zinc and cadmium) originating from mine wastes and workings (EPA, 2002). Similarly, reduced trout numbers in the Blue River below the confluence with French Gulch are also likely associated with metal toxicity and poor aquatic habitat conditions.

Upstream from the W-O Mine Site, water quality conditions and an undisturbed habitat support a healthy population of Colorado River cutthroat trout, as well as benthic invertebrates (EPA, 2002). A physical fish barrier and the poor water quality currently minimize the likelihood of migration of non-native fish species into the undisturbed cutthroat trout habitat. The physical fish barrier consists of the culvert pipe that has a six to seven-foot drop in elevation to French Gulch. Improvements in the water quality are likely to require sufficient physical protection of this population from non-native species migration.

A 2007 series of removal activities were initiated in order to address existing sources of surface contamination and concerns over survival of native fish species. These activities included excavation, consolidation, capping waste rock and spent mine tails, stream diversion, and construction and operation of a water treatment plant. In 2008, the water treatment plant began operations to treat water discharge from a W-O Mine seep. The treatment plant can treat up to 150 gallons per minute of mine discharge. Treated water is injected into the alluvial groundwater of French Gulch. The water treatment plant was designed to remove 90% of cadmium and 99% of zinc from the collected mine drainage.

In 2009, ESAT and EPA personnel conducted a series of three sampling events at the site to characterize surface water (dissolved and total recoverable metals, alkalinity, anions, and dissolved organic carbon), sediment (total recoverable metals), and pore water (dissolved and total recoverable metals, alkalinity, and anions). In addition, flows were measured, field water quality measurements were collected (pH, dissolved oxygen [DO], temperature, and conductivity), habitat was assessed (following rapid bioassessment protocols), and macro-invertebrate assemblages were identified. The following locations were sampled during the 2009 sampling events: BR-1, BR-2, Dead Elk Pond (five locations), FG-8A, FG-2, FG-4, FG-5, FG-5.5, FG-5.5A, FG-6C, FG-8, FG-9, FG-9A, and two seep inputs to Dead Elk Pond.

During the 2010 and 2011 sampling seasons, ESAT members conducted three sampling events at the same locations as those listed for the 2009 sampling season. During these events, water quality measurements were collected for the same parameters listed above. Samples were analyzed for total recoverable metals and dissolved metals analysis only. Flow measurements were made at sites FG-9, BR-EPA2, and BR-1 during 2010 and sites FG-9, FG-9A, FG-5.5, FG-5, and FG-8 in 2011. Additionally, four opportunity stations were sampled for total recoverable metals and dissolved metals during the 2011 season.

In 2012, 2013, 2014 and 2015 ESAT and EPA personnel conducted three sampling events in order to determine the metal concentrations in the early, high and low-surface water flow regimes. The 2012 through 2015 sample locations were the same as those sampled in 2009-2011 with a few additions due to non-attainment of water quality standards: BR-3, BR-EPA1, BR-EPA2, BR-EPA2U, 12304A, and 7 opportunistic samples. In 2015 efforts were made to identify any new seeps that were not previously identified. Surface water samples for total and dissolved metals and field water quality measurements were collected during the events. Stream flows were measured at sites BR-EPA2, FG-9, FG-9A, FG-8, FG-5.5, FG-5, Opp 1, and Opp 5. The sampling locations in

2016 were the same as those in 2012 to 2015 with the addition of four new seeps that were identified around Dead Elk Pond.

## 1.2 Objective

The 2017 sampling events were conducted to determine stream conditions during early (May), high (June), and low (September) flow regimes and current groundwater conditions. The events were also conducted to determine if zinc and cadmium fall outside of attainment levels for the State of Colorado water quality standards. Where appropriate and feasible, data collected during these sampling events will be compared to data from previous years in order to assess the effectiveness of the water treatment plant.

# 2.0 SAMPLING ACTIVITIES AND PROCEDURES

Field activities at the French Gulch W-O Mining Site took place during May, June, and September of 2017. Any deviations from the SAP/QAPP are identified in Section 4.0. Specific activities included the following:

- May 28, 2017
    - Real-time field water quality parameters
    - Stream discharge measurements: using Sontek® Flow Tracker™ flow meters
    - Surface water: total recoverable metals and dissolved metals
    - Sample collection documentation
    - Photo documentation
    - Groundwater well depths
    - Global Positioning System (GPS) coordinates of Groundwater monitoring wells

- June 13-14, 2017
    - Real-time field water quality parameters
    - Stream discharge measurements: using Sontek® Flow Tracker™ flow meters
    - Surface water: total recoverable metals and dissolved metals
    - Groundwater: total recoverable metals and dissolved metals
    - Sample collection documentation
    - Photo documentation

- September 20-21, 2017
    - Real-time field water quality parameters
    - Stream discharge measurements: using Sontek® Flow Tracker™ flow meters
    - Surface water: total recoverable metals and dissolved metals
    - Groundwater: total recoverable metals and dissolved metals
    - Sample collection documentation
    - Photo documentation

## 2.1 Sample Handling and Identification

Surface water samples collected were identified by the stream name followed by a station number. For example, locations in Blue River were identified as BR–##, with the station number corresponding to its location along the stream. Likewise, locations along French Gulch were identified as FG–##. Duplicate samples were indicated with the abbreviation "Dup" followed by a number corresponding to the order the duplicate samples were collected.

Groundwater samples collected during these events were identified as MW-## for monitoring well followed by the well's station number.

Opportunistic samples collected during these events were identified as "Opp" followed by a number. During the 2011 and 2012 sampling seasons, five Opp samples were identified. An additional three Opp samples were identified during the May 2016 event. Five new seeps were identified during the June 2017 event around Dead Elk Pond and an additional Opp sample was collected near the now covered up location Opp-2. Below is a table of Opp samples, a site description, and GPS coordinates for seeps that were sampled during the 2017 sampling events.

| LOCATION ID | DESCRIPTION | LATITUDE | LONGITUDE |
|---|---|---|---|
| Opp-1 | Seep from underneath rock pile approximately five meters south of FG-5 culvert outflow. | 39.481579 | -106.014891 |
| Opp-2 | Sampled from the black corrugated pipe about ten meters west of site FG-6C. This location is now covered in large rocks. It could not be sampled this year. | 39.481322 | -106.018972 |
| Opp-3 | Seep coming from the west end of W-O neighborhood. | 39.485645 | -106.028042 |
| Opp-4 | Small trickle of water North side of road, 100 feet downstream of the water treatment facility. | 39.482461 | -106.015877 |
| Opp-5 | Downstream of water treatment plant. Subsurface discharge where several channels come together by an evergreen tree. | 39.481567 | -106.016218 |
| Opp-9 | Downstream of FG-6A near the gate. Orange pond is forming under the rocks by the new trail and is flowing next to the road. | 39.481422 | -106.018503 |
| Opp Seep-1 | Seep is located on left side of French Gulch just upstream of Dead Elk Pond. | 39.485207 | -106.029066 |
| Opp Seep-3 | Seep is located on South side of Dead Elk Pond close to where French Gulch enters pond. | 39.485274 | -106.028793 |
| Opp Seep-4 | Seep is located just upstream of FG-8, under bridge. | 39.485069 | -106.028596 |
| Opp Seep-5 | Seep is flowing into Opp-3 pond | 39.485644 | -106.027908 |
| Opp Seep-6 | Seep is flowing into Opp-3 pond | 39.485640 | -106.027893 |

| | | | |
|---|---|---|---|
| Opp Seep-7 | Seep is flowing into the wetland just to the west of DEP-Seep2 | 39.485679 | -106.028172 |
| Opp Seep-8 | Seep is located just upstream of FG-8, under bridge on the west bank of French Gulch | 39.484926 | -106.028681 |
| Opp Seep-9 | Seep is located just upstream of FG-8, under bridge on the west bank of French Gulch | 39.484938 | -106.028667 |

## 2.2 Surface Water Sampling

Surface water samples were collected at locations along Blue River, French Gulch, and numerous seeps in accordance with Standard Operating Procedure (SOP) FLD-01.00 *Surface Water Sampling* (EPA, 2012) and the *Final Sampling Analysis Plan/Quality Assurance Project Plan, French Gulch Wellington-Oro Mining Site, Breckenridge, Colorado* (ESAT, 2017).

Water samples for dissolved metals analysis were collected in certified clean 250 milliliter (mL) High Density Polyethylene (HDPE) bottles after a triple rinse with water from the sample location, then transferred and filtered through a 0.45-micron filter apparatus into a 250 mL sample container. The 250 mL HDPE bottle used to transfer the dissolved metals sample was refilled for total recoverable metals analysis.

Samples for total recoverable and dissolved metals analysis were preserved with nitric acid in accordance with SOP FLD-03.00 *Sample Preservation* (EPA, 2012). The date, time, and sampler's initials were written on the Chain of Custody (COC) tracking form and the pre-printed label in accordance with SOP FLD-11.00 *Sample Custody and Labeling* (EPA, 2012). The label was affixed to the sample container and covered with clear tape to prevent loss of the label or information. After preservation, all samples were placed in a cooler with ice for transport to the EPA Region 8 Laboratory and stored in the four-degree Celsius laboratory walk-in cooler until analysis. Samples were analyzed for total and dissolved metals (EPA method 200.7 and 200.8) and hardness (EPA method 2340B calculated from calcium and magnesium results). Surface water analytical results for the 2017 sampling events are included in **Table 1** through **Table 6.**

## 2.3 Groundwater Sampling

Groundwater samples were collected at monitoring wells during the June and September sampling events in accordance with SOP FLD-04.00 *Groundwater Sampling* (EPA, 2012). The static water level and total depth measurements were collected using a water level indicator. The monitoring well was then purged using a bailer until water quality (pH, conductivity, temperature and DO) stabilized. After stabilization, samples for total recoverable metals analysis were collected in 250 mL HDPE bottles and samples for dissolved metal analysis were collected in 250 mL Nalgene filter bottles and filtered on-site. Bailers were disposable and station dedicated, therefore decontamination was not required.

Groundwater samples were preserved with nitric acid in accordance with SOP FLD-03.00 *Sample Preservation* (EPA, 2012). The date, time, and sampler's initials were written on the COC tracking form and the pre-printed label in accordance with SOP FLD-11.00 *Sample Custody and Labeling* (EPA, 2012). The label was affixed to the sample container and covered with clear tape to prevent loss of the label or information. After preservation, all samples were placed in a cooler with ice for transport to the EPA Region 8 Laboratory and stored in the four-degree Celsius laboratory walk-in cooler until analysis. Groundwater samples were analyzed for dissolved metals and total recoverable metals (EPA methods 200.7 and 200.8), and hardness (EPA method 2340B calculated from calcium and magnesium results). Analytical results are shown in **Table 3** through **Table 6** and water quality results in **Table 8** and **Table 9**.

## 2.4 Water Quality and Discharge Measurements

Field water quality measurements (pH, water temperature, DO, and specific conductance) were collected at each water sampling location using a YSI EXO multi-parameter meter or a YSI pro multi-parameter meter. Water quality measurements were collected in accordance with manufacturer guidelines presented in *EXO User Manual- Advanced Water Quality Monitoring Platform* (YSI, 2017) and the *Professional Plus User Manual* (YSI, 2009). All water quality and discharge results were recorded in an Electronic Data Collection Device (EDCD) or a Groundwater sampling data sheet (**Appendix C**) when measured.

Stream discharge was measured at select locations using Flow Tracker® flow meters during the May, June, and September sampling events. Stream discharge measurements collected with a Flow Tracker® were done in accordance with SOP FLD-08.00 *Flow Tracker Operation* (EPA, 2012) and results are included in **Appendix A**. Discharge measurements are also included in the EDCD entries (**Appendix B**) and **Table 7** through **Table 9**.

## 2.5 Sample Documentation

During sampling activities, an EDCD was used to document field activities in accordance with Field Quality Procedures *Survey123 for ArcGIS* (EPA, 2017) and *Field Data Collection Using GPS and Collector for ArcGIS* (EPA, 2017). The following information was recorded: date, time, location coordinates, sample bottle lot numbers, weather conditions, sampling personnel, water quality measurements, equipment ID numbers and other pertinent observations (**Appendix B**). EDCDs were also used to take photos that documented field sampling activities. Photos are provided in **Appendix D**. Samples submitted for laboratory analysis were entered into a chain of custody system using Scribe. All analytical chemistry data, field water quality measurements, and discharge estimates were also entered into Scribe.

# 3.0 SAMPLE QUALITY CONTROL

This section details quality control methods used in the field for activities performed during the sampling effort. These include decontamination methods, field instrument calibration, duplicate sample collection, and field blank sample collection.

## 3.1 Decontamination Methods

All sample bottles and bailers were certified pre-cleaned and location dedicated, therefore decontamination was not required. All water filters and filter apparatuses were also new and not reused between sampling locations.

## 3.2 Field Instrument Calibration

Field instrumentation requiring calibration or routine function checks included the water quality meters and the Flow Tracker® flow meters. In accordance with *EXO User Manual- Advanced Water Quality Monitoring Platform* (YSI, 2017) and the *Professional Plus User Manual* (YSI, 2009), the water quality meters were calibrated daily for pH, conductivity, and DO. Conductivity and pH were calibrated with established pH buffers and conductivity standards per the manufacturers' specifications. DO was calibrated using the saturated air approach on a daily basis. All calibration procedures were recorded in the instrument's calibration notebook and are included in **Appendix E**. The Flow Tracker® flow meters have automatic QC tests (beam checks) that are conducted prior to data collection and are shown in **Appendix A**.

## 3.3 Duplicate Sample Collection

Duplicate samples were collected at a ten percent frequency to determine sampling precision and correlation between samples. According to the *EPA National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2017), a control limit of twenty percent for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times the Contract Required Quantitation Limit. Although these are laboratory guidelines which may not apply to all field situations, an RPD was calculated for duplicate total and dissolved metals. RPD values were calculated using the following equation:

RPD =100 * [Absolute value (Sample Result – Duplicate Result)] / [(0.5 * (Sample Result + Duplicate Result)]

RPD values are provided with analytical results in **Table 1** through **Table 6**.

## 3.4 Field Blank Samples

Field blank samples were collected to evaluate the potential for sample contamination during collection, transport to the laboratory, and at the laboratory. Aqueous field blank samples were processed in the field using laboratory grade de-ionized water. Blank

sample processing and handling was similar to field samples. Blank samples were collected at a frequency of one per day and analyzed for total recoverable metals and dissolved metals. Field blank sample analytical results are included in **Table 1** through **Table 6**.

## 4.0 FIELD CHANGES AND CORRECTIVE ACTIONS

Below is a summary of deviations from the 2017 SAP/QAPP that occurred in the field during the May, June, and September 2017 sampling events:

May 23, 2017

- Opportunity samples were renamed after sample collection to match past years' nomenclature. The names included in Scribe and this SAR are the renamed versions.
- The opportunity locations Opp Seep-1 and Opp Seep-4 were collected around Dead Elk Pond.
- The following locations were dry and samples were not collected: Opp-3, DEP Seep-2, and FG-6C.
- Location Opp-2 no longer exists and was not sampled. A walking path was created through the old pond and large rocks now cover this location. However, further downstream orange water was found flowing through the rocks and an opportunity sample was collected and called Opp-9.
- As instructed, the locks were cut on monitoring wells MW-20, MW-2, MW3, MW-11, MW-9, and MW-7 to be able to obtain total well depth and static water levels from the wells. MW-4 did not have a lock but total depth and static water level data were collected.
- The following monitoring wells could not be located: MW-1, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, MW-18, MW-19, MSRW-3, EXO-1, EXO-2 and WTL-2.

June 13-14, 2017

- Opportunity samples were renamed after sample collection to match previous years' nomenclature. The names included in Scribe and this SAR are the renamed versions.
- The following opportunistic locations were sampled around Dead Elk Pond: Opp Seep-1, Opp Seep-4, Opp Seep-5, Opp Seep-6, Opp Seep-7, Opp Seep-8, Opp Seep-9.
- Location Opp-2 no longer exists and was not sampled. As described above, a walking path was created through the old pond and large rocks now cover this location. Further downstream orange water was found flowing through the rocks and an opportunity sample was collected and called Opp-9.
- Stream discharge measurements could not be collected at location Opp-1 because this seep was flowing directly into the pond without channelizing.

- Due to unsafe conditions, stream discharge measurements were not collected at locations FG-9A, FG-5.5 and FG-5.
- Groundwater was only sampled from the monitoring wells that were located during the May event. An effort was made to find the missing wells but they could not be located.
- MW-4 was an artesian well and was sampled directly from well with a sterile syringe and water quality parameters were measured in the calibration cup.

<u>September 20-21, 2017</u>

- Opportunity samples were renamed after sample collection to match past years' nomenclature. The names included in Scribe and this SAR are the renamed versions.
- The following locations were dry and samples were not collected: DEP-Seep-1, DEP-Seep-2, FG-6C, FG-8A, Opp-3, and Opp-4
- Location Opp-2 no longer exists and was not sampled. As described above, a walking path was created through the old pond and large rocks now cover this location. Further downstream orange water was found flowing through the rocks and an opportunity sample was collected and called Opp-9.
- Stream discharge measurements could not be collected at location Opp-1 because this seep was flowing directly into the pond without channelizing.
- Groundwater was only sampled from the monitoring wells that were located during the May event.
- The total depth and static water level of the monitoring well were measured the day after sampling due to a faulty water level indicator.

# 5.0 REFERENCES

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